Ergonomically Designed Fishing Equipment to Improve the Occupational Safety and Health Among Fisherfolks at Jala-Jala, Rizal

Gallardo, Christine Joy B., Oliveros, Zina Marie G., Ople, Vazh Chloey V., Protacio, Etthandan Zeus C., Sibulan, Kenneth Dane S.
Industrial Engineering Department
Technological Institute of the Philippines – Manila
mcjbgallardo@tip.edu.ph, mzmgoliveros@tip.edu.ph, mvcvople@tip.edu.ph, mezcprotacio@tip.edu.ph, mkdssibulan@tip.edu.ph

Janina Elyse A. Reyes
Industrial Engineering Department
Technological Institute of the Philippines- Manila
janina.elyse.reyes@gmail.com

Abstract

This study examines the postures that put fisherfolk in Jala-Jala, Rizal at risk of work-related musculoskeletal disorders and provide ergonomic solutions to improve their performance. Job demand analysis and interviews revealed the factors affecting fisherfolk's jobs. Mr. Basig, the agriculture sector representative in Jala-Jala Rizal, claimed that 90% of the 1,800 fisherfolk aged 40 to early 60s had hip and back pain. 60% of fisherfolk also get fish thorn cuts and stings when lifting nets. Analysis of Variance, Tukey Comparison Analysis, Pareto Chart, Root-Cause Analysis, Rapid Entire Body Assessment (REBA), and 5S Lean Methodology were used to conduct the investigation gradually. Thus, fisherfolk routinely pull and carry nets, scoop fish, and pull rope, which statistical study has proven to pose ergonomic dangers. The REBA Analysis classifies these three fishing activities as Action Level 4 high-risk. Therefore, the researchers conceptualized ergonomically designed fishing equipment as well as a working process layout that improves the working condition and lessens the physical discomfort of the fisherfolk. The designed equipment has given the researchers a degree of improvement in the posture of fisherfolk's top three activities by 47.50% in fishing net pulling and carrying, 46.15% in fish scooping, and 21.74% in rope pulling.

Keywords
Fisherfolk, Work-Related Musculoskeletal Disorder, Rapid Entire Body Assessment, Analysis of Variance, Ergonomically Designed

1. Introduction
The local fishing industry or aquaculture contributes significantly to the country's food security, employment opportunities, and national economy. The Philippine Statistics Authority (2016) reports that each Filipino consumes 98.6 grams daily. It proved that the Philippines benefits greatly from the fishing industry because it provides a large portion of the country's requirement for animal protein, employs many people with the highest socioeconomic status, and generates a substantial amount of foreign currency.

According to the findings of the Fourth European Working Conditions Survey, 35% of all workers, including skilled agricultural and fishery workers are particularly at risk due to repeated action, uncomfortable stances, and holding and relocating large objects for at least a quarter of their work schedule. These factors contribute to the development of musculoskeletal disorders. Moreover, as we look at or observe, the review and study of the occupational safety and health of workers in the fishing industry are still inconsequential in the country and that’s the factor why researchers thought about conducting this study.

As per correlation with the local fishing industry, traditional fishing techniques and tactics are still used by small and medium-scale fisherfolk in the Philippines. However, it reports that fisherfolk do not have enough access to any safety measures or personal safety equipment that could protect them from any physical risk (Naga et al. 2018). As a result, Work-related Musculoskeletal disorders should be avoided or, at the very least, minimized as much as possible in general, and small to medium-scale fisherfolk are required to investigate and improve their working conditions to provide better and safer working conditions for their workers.

1.2 Objectives

This study will identify work-related musculoskeletal problems that affect fisherfolk in Jala-Jala, Rizal. The researchers will also create a problem-solving technique to reduce musculoskeletal disorders (MSDs) and other risk factors in fishing workers to improve work conditions and processes.

Specifically, this study aims to:

1. To determine the actual tasks and evaluate the physical and environmental needs of a fishing job through a job demand analysis approach.
2. To fulfill a postural and material handling analysis by using the Rapid Entire Body Assessment (REBA) method for fishery workers in Jala-Jala, Rizal.
3. To perform a Root-Cause Analysis (RCA) to identify the underlying cause of risk factors that fishery workers encountered in the workplace.
4. To create a 5S Lean Method to plan and arrange the fishery's working system to boost worker productivity.
5. To analyze survey variables using Analysis of Variance and Interval Plot.
6. To establish an ergonomically designed layout and equipment to help fisherfolk reduce disproportionate force, and physical injuries, and improve work conditions and operations.

1.3 Scope and Delimitation of the Study

This study focuses on providing an occupational health and safety analysis of the Fishery in Jala-Jala, Rizal by observation and interviews of the working system of the fishery with relation to the workers' posture and the material handling they perform while on the job. The scope of the inquiry only concentrated only 327 respondents out of 1800 fisherfolk surveyed or utilized by the researchers in 10 out of 11 Barangays in Jala-Jala, Rizal.

1.4 Significance of Study

The researchers not only observed, analyzed, and measured the issues and risk factors in the fishery work sector but also helped them to improve the fisherfolk's work conditions or processes and find a solution by designing ergonomic equipment that aided, reduced the physical injuries and other risk factors or underlying cause that can negatively affect their work performance and well-being. The following individuals or groups play a significant role in the study the fishery workers in Jala-Jala, Rizal, the head of the fisheries organization, the fisheries sector, for future researchers.

2. Literature Review

According to the study by Borah, B. (2018), 84–96% of fishery employees reported experiencing work-related musculoskeletal disorders and discomforts. 92–100% of workers who spent a long time in water or wet circumstances suffered muscle injuries, wounds, skin infections, eye issues, gastrointestinal illnesses, bronchial disorders, and lung disorders. The largest incidence of MSD was reported in the lower back (86.4%), wrist and hand (73.5%), and upper back (66.8%) (Müller 2 022). These variables may cause detrimental fishing for fisherfolk and the ecosystem. As a result of unregulated and destructive fishing tactics, there will be fewer fish to capture in the future.

Based on the study of Daika (2019), a small fishing community's traditional labor includes bending, standing, crouching, and leg bending. Thus, patients with musculoskeletal diseases often experience pain in particular situations (MSDS). Musculoskeletal disorders can include pains, aches, and even a fever. Fisherfolk must spend 50% of their time fishing with conventional vessels and gear to make a living. This explains why so many fishermen have post-work discomfort.

In the current study by Fragoso et al. (2018) musculoskeletal problems can cause considerable pain or discomfort, thus most retire or stay at home. Musculoskeletal Conditions in fisherfolk are really vital since there are still no preventive measures implemented among them. This shows that the work health continuing education to lessen

dangers induced by repetitive effort, among others. Those initiatives must also be connected to the Fishery Department and Aquaculture, enhancing their living, work, and health conditions.

Rahman et al. (2018) say Filipino men stand at 167 cm, or 5.5 feet. However, the researchers based the roller to stand height at 137.5 cm or 4.5 feet long and the stand to valve or controller of fish net roller height at 120 cm or 4 feet long so that fisherfolk can easily use it since it is appropriate and the same as the shoulder height for the standard standing height or posture for Filipino working male

According to Ishikawa et al. (2022) a link between fisherfolk's musculoskeletal problems and their work's physical demands, age-related disparities in their jobs, and interpersonal dynamics. Musculoskeletal problems in fishermen most often manifest in the lumbar back (83.7%), hands/wrists (60.5%), and shoulders (53.5%). There was a correlation between these musculoskeletal complaints and factors including age, the number of years in the workforce, the kind of job performed, and interpersonal conflict.

Fish farmers spend a significant portion of their working day physically engaged, and they regularly perform repeated tasks, heavy lifting, lengthy periods of standing, and uncomfortable postures. High levels of occupational physical activity (OPA) increase the likelihood of cardiovascular problems and musculoskeletal disorders. These factors affect the work performance, comfort, and health of the workers negatively (Sandsund et al. 2022).

Ngaruiya et al. (2019) found 2.78 million worker medical deaths annually. 20%–50% of workers, especially in developing nations, are sick. Fishing—like other hobbies—is dangerous. Kenya's Lake Baringo fish processing endangered fishermen. According to the study, fishermen get scrapes, sunburns, scalds, colds, accidents, and injuries. 12% of fishermen wear PPE. All Kampi Samaki fishermen risk workplace injuries. Health programs must teach fishermen first aid and seafood safety.

Based on the study Campos (2020), Small-scale fishermen and other rural workers' safety and health depend on community involvement and primary healthcare Latin America needs public policy, an integrated vision of human health, and health professional training to include workers' health in basic healthcare

According to Doza et al. (2021), the fishing profession is physically demanding and full of repeated work. Fisherfolk often express vulnerability, non-standard working conditions, frequent overnights, and shifting duty. Finally, 33% of people experienced carpal tunnel syndrome.

According to Thamrin et al. (2021), occupational safety and health safeguard workers against working dangers and illnesses. Fisherfolk are especially stressed out (constant motion, cold, noise, heavy lifting, awkward working positions, lengthy shifts, and high levels of stress).

3. Methods

3.1 Research Design

This study is an instance of applied research, which is an investigation that makes use of the employing of scientific methods with the goal of creating empirical observations with the intention of resolving crucial issues in the area of the fishery. The researchers made use of this in a wide range of settings, spanning imposed physical behavior analysis to assess the instruments that the fisherfolk make use of. This kind of research can be carried out using a mixed-method research design, which brings together quantitative and qualitative data segments inside the same project.

3.2 Sources of Data

The data for the study came from both primary and secondary sources.

a. Survey Questionnaire

The researchers used a survey as a tool to collect the fisherfolk data and information that can be utilized for the research's main objective and in the general study.

b. Google Scholar

The researcher selected journal articles from google scholar that have good credentials for getting relevant studies to back up or support the current study as the quickest option to locate related literature.

3.3 Materials and Method

The researchers utilized Google Forms, Google Sheets, Minitab, and Microsoft Excel for encoding and analysis of data. On the other hand, the methods that the researchers used are the job demand analysis which aims to pinpoint the detail or precise physical, and environmental demand of an occupation specified by the fisherfolk. They also used the Ishikawa diagram which is the process of identifying the specific problem of the (fishery) in terms of manpower, machines, methods, and materials. Analysis of Variance (ANOVA) and Tukey Pairwise Comparison of Means gives a statistical test to see if the hypotheses are accepted or rejected. A Pareto chart is used to help this study to determine the priority or the main problem that makes a major impact on the root cause of a certain situation. The researchers make use of Rapid Entire Body Assessment (REBA) which is the technique that utilizes a structured approach to analyze the threats of MSDs (Musculoskeletal Disorders) for both the human body as well as the associated risks with ergonomically designed workplaces. The 5S Lean Method, which is the sort, set in order, shine, standardize, and sustain, helped this study plan and organize the fishery's working system, which will help them be more efficient in productivity and time. For the research recommendation, basic ergonomic equipment was also designed to assist the fisherfolk, as the plan will help them minimize some injuries.

3.4 Mathematical Expressions and Symbols

3.4.1. Sampling Technique

The researchers used the Judgmental Sampling technique for this study to adhere to the respondents which are based on their availability and convenience. Through Slovin's formula, researchers obtain the number of the sample size required to determine a more accurate number of respondents.

$$n = \frac{N}{(1 + Ne^2)} \quad (1)$$

n= number of samples
N= total population
E= margin of error
1= constant value

The researchers utilized Slovin's formula, which provides the data necessary for locating the sample with a 5% error margin. 327 respondents were selected from a total population of 1,800 fisherfolk in Jala-Jala, Rizal.

4. Result and Discussion

4.1 Interpretation of Physical Interview and Survey Results

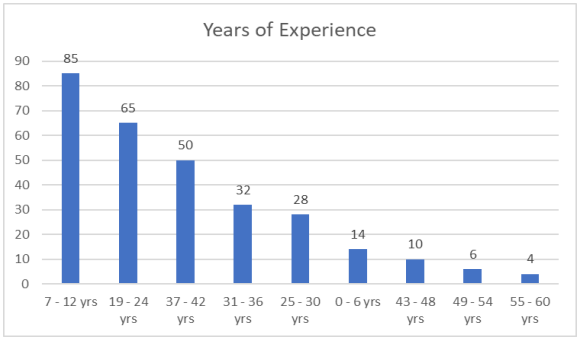


Figure 4.1.1 Years of experience

Most of the respondents in this survey were with 7 to 12 years of experience, accounting for 22.63% of the total population.

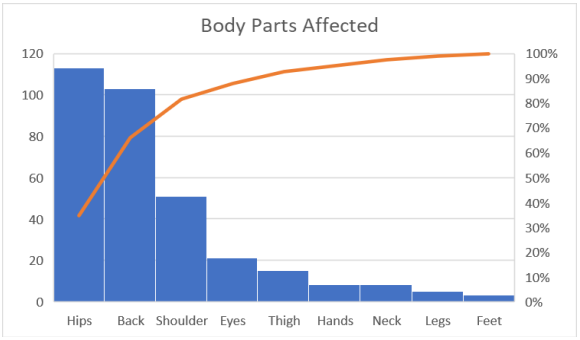
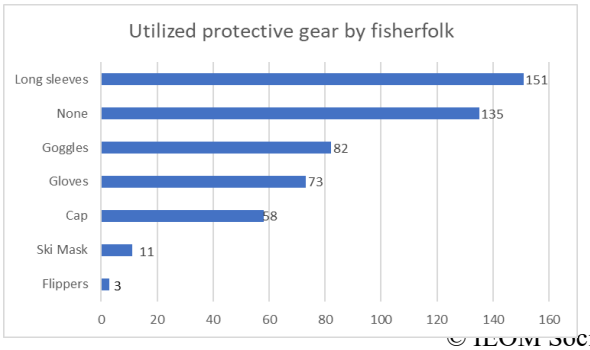


Figure 4.1.2 Body part affected

The hips, the back, and the shoulders are shown to be the most significant of the nine body parts that are impacted by the work of fisherfolk.



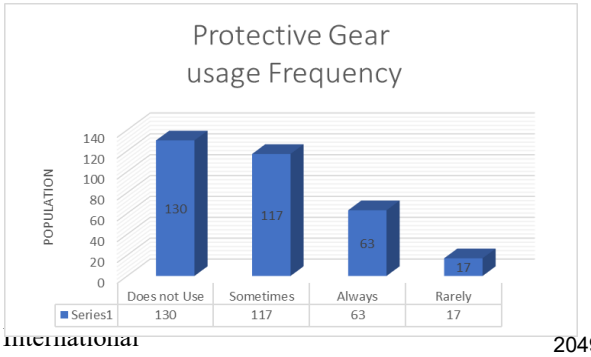


Figure 4.1.3 Utilized protective gear by Fisherfolk

151 or 46.18% of the total respondents use long sleeves as their protective gear while fishing. While 135 or 41.28% of the total respondents do not wear any protective gear while fishing.

Figure 4.1.4 Protective Equipment Usage Frequency

Among respondents,130 or 39.76% are never use protective gear while 117 or 35.78% of respondents are frequently using. Only 63 or 19.27% of respondents are always using the stated protective gear.

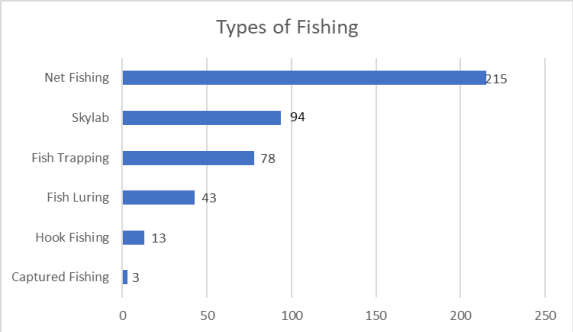


Figure 4.1.5 Type of Fishing

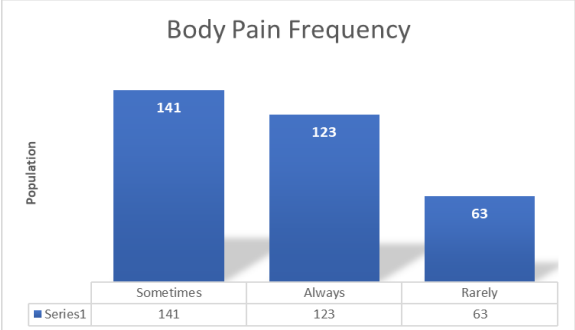


Figure 4.1.6 Body Pain Frequency

The most common type of fishing is net fishing, which is also the most well-known and traditional technique. In this type of fishing, a net is being thrown and it is typically equipped with a weight so that it can sink into the water. Next is the Skylab which is quite similar to fish trapping, which also involves the utilization of a cage in the water and waiting for a couple of minutes in the chances that a fish would come into the cage and become trapped inside.

123 respondents which are 37.61% of them state that they always experience body pain, 141 or 43.12% claim that they frequently experience body pain, and 63 or 19.27% admit that they only rarely experience body pain.

4.2 Fishbone Diagram

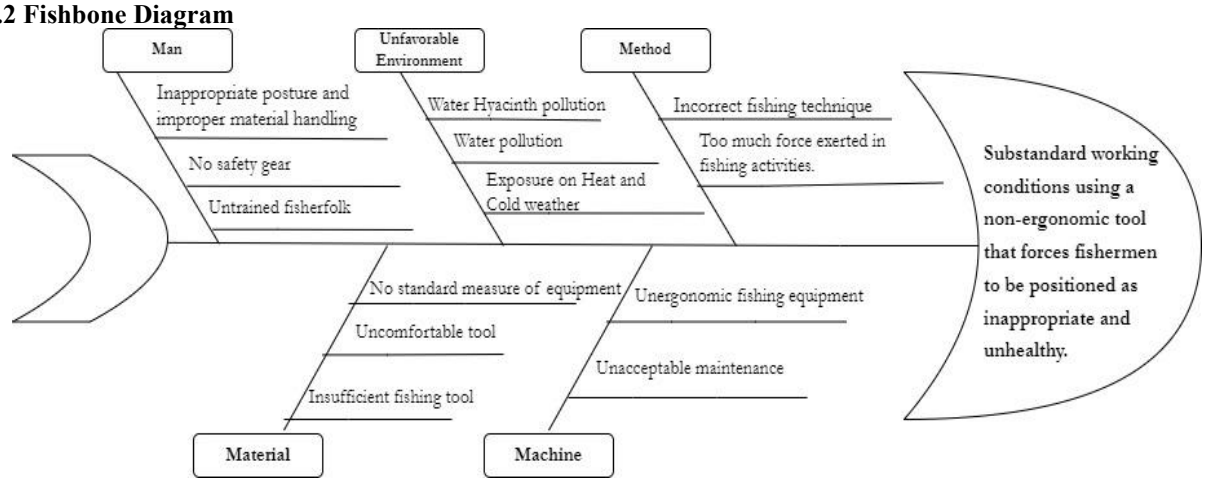


Figure 4.2.1 Ishikawa Diagram

4.3 One-way Analysis of Variance Results

Section 1. Factors that correlate to the Routine actions of the fisherfolk affecting their work and body posture

Hypothesis:

Null hypothesis: There is no strong relation between the fisherfolk's activities that affect their body posture with their body parts affected and years of experience.

Alternative hypothesis: There is a strong relationship between the fisherfolk's activities that affect their body posture with their body parts affected and years of experience.

Table 4.3.1 Analysis of Variance p-value results that affects Routine Action

Variables	Body parts affected	Years of Experience
Task in Fishing that affects body pain	0.00	0.041

The fisherfolk's task to their affected body parts is depicted in Table 4.2.1. According to the graph, there is a significant correlation between the fisherfolk's task and their affected body pain. It implies that all body parts are correlated to each other and all body parts are prone to body pain because they are connected and frequently used in various activities or tasks related to fishing such as pulling and carrying the net, scoop fishing, and rope pulling. The data shows a significant relationship between the fisherfolk's years of experience in fishing and the impact of their tasks on body pain. According to ANOVA, the groups are significantly different from each other. Specifically, those who are new to fishing (apprentices) are more likely to experience task-related body pain than those who are experts in the field. Thus, the level of pain experienced during fishing tasks can vary based on the individual's years of experience.

Section 2. Factors that affect the safety and security of fisherfolk

Hypothesis:

Null hypothesis: There is no meaningful correlation between fisherfolk's body pain frequency and affected body parts with their personal protective equipment, personal protective equipment usage frequency, and other fishing problems.

Alternative hypothesis: There is a meaningful correlation between fisherfolk's body pain frequency and affected body parts with their personal protective equipment, personal protective equipment usage frequency, and other fishing problems.

Table 4.3.2 Analysis of Variance p-value results summary

Variables	Personal Protective Equipment	Personal Protective Equipment Usage Frequency	Other Problems affecting Fishing
Affected Body Part	0.00	0.40	0.00
Body Pain Frequency	0.00	0.01	0.00

Table 4.3.2 shows a significant relationship between fisherfolk affected body parts in their personal protective equipment, personal protective equipment usage frequency, and other problems affecting fishing, as the p-values are all less than the significance level of 0.05. This means the null hypothesis is rejected and these three factors are considerably correlated to their affected body part. Similarly, there is a significant relationship between affected body parts and personal protective equipment and other problems affecting fishing, resulting in the rejection of the null hypothesis. In contrast, there is no significant correlation between affected body parts and personal protective equipment usage frequency (p=0.40), so the null hypothesis is accepted.

Section 3. Knowledge about Proper Material Handling

Hypothesis:

Null hypothesis: There is no significant relationship between the material handling seminar offered and the frequency of seminars offered to fisherfolk in the fisherfolk's type of fishing.

Alternative hypothesis: There is a significant relationship between the material handling seminar offered and the frequency of seminars offered to fisherfolk in the fisherfolk's type of fishing.

Table 4.3.3 Analysis of Variance p-value results summary

Variables	Type of Fishing
Material Handling Seminar Offered	0.57
Frequency of seminars that are being offered	0.04

It shows that they are statistically significant in the types of fishing in relation to the frequency of seminars occurring in Jala-Jala, Rizal. However, it entails that when it comes to the types of fishing the task varies due to the procedures implemented, which makes it significantly different. It also states that no matter what type of fishing the fisherfolk have, there is a connection between how often the seminar for material handling is implemented.

4.4 Rapid Entire Body Assessment (REBA) Analysis

Figure 4.4.2 ***Pulling and Carrying of Fishing Net***

Figure 4.4.3 *Scooping of Fish*

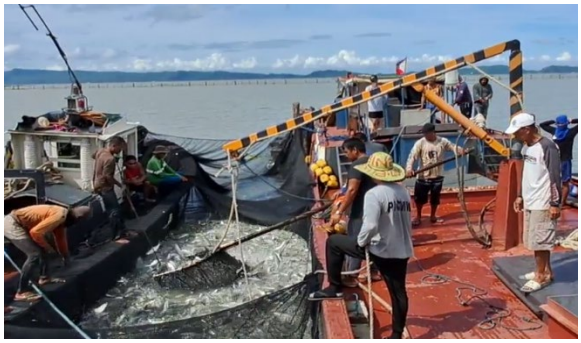


Table 4.3.1 Result of REBA

Parameters	**Pulling and carrying of Fishing Net**		**Scooping of Fish**		**Pulling of Rope**	
	Observed Values	*Expected Values*	*Observed Values*	*Expected Values*	*Observed Values*	*Expected Values*
Neck	2	1	2	2	2	2
Trunk	3	2	3	2	2	2
Legs	3	1	3	1	2	3
Table A Posture Score	6	2	6	3	4	6
Force/Load Score	3	2	3	2	2	3
SCORE A	9	4	9	5	6	9
Upper Arm Position	2	3	4	4	4	3
Lower Arm Position	1	2	2	2	2	2
Wrist Position	2	1	3	1	1	2
Table B Posture Score	3	4	7	5	5	
Coupling Score	1	0	2	0	0	1
SCORE B	5	4	9	5	5	6
Activity Score	2	2	2	1	1	2
Table C	9	4	11	6	8	10
REBA SCORE	**11**	**6**	**13**	**7**	**9**	**12**
RISK LEVEL	**Very High**	**Medium**	**Very High**	**Medium**	**High**	**Very High**
Percentage Improvement	**47.50%**		**46.15%**		**21.74%**	

The pulling and carrying of the net have obtained a total score of 11, net fish scooping has a REBA score of 13, which is also the heaviest work that the fisherfolk do, and pulling of rope has a score of 12, and all three of these activities are classified as Action level 4, which indicates a very high level of risk. The REBA scores were achieved using the

REBA method. This indicates that from this period, it is going to be necessary to create enhancements for the fisherfolk, either in the working system, the fishing materials, or the working environment.

4.4 5S Lean Method

Figure 4.4.1 Actual Workplace Condition

The figure above, illustrates the documentation or images of the actual workplace condition of fisherfolk in Jala-Jala Rizal. It depicts the area inside the fishing vessel where a variety of fishing activities occurs. The arrows in the image show the different types of hazards scattered on the fishing vessel's floor Rope (1), Basin (2), Hollow Blocks (3), Planks (4), Fish Storage Cover (5), Wet Floors (6), Anchor (7), and Sack of Salt (8). Furthermore, the table below are the detailed existing problems or concerns of fisherfolk that are based on the application of the 5S Lean Method.

Table 4.4.1 *5S Lean Method*

5s	Existing Problem/ Concern
Sort	Tripping hazards like ropes and disorganized fishing nets are left on the deck, along with anchors, pails, and buckets. Personal protective equipment is not consistently used and tools and equipment are disorganized and obstructive. There is poor storage on the vessel and unnecessary items are randomly placed on the deck. The storage room cover is blocking a crucial area.
Set in Order	Proper storage on the fishing vessel is lacking, and the skiff boat has unnecessary equipment like empty drums. The storage room cover is blocking a crucial area, and superfluous materials like hollow blocks are randomly scattered on the vessel.
Shine	There are slips in the workplace due to water drops on the fishing vessel, and the machines and equipment are not properly maintained and cleaned. There are also oil leaks from engine malfunction on the fishing vessel.
Standardize	The fisherfolk do not have instructions on proper equipment operation or preventative maintenance procedures
Sustain	There is no endorsed policy on personal protective equipment, leading to inconsistent use. Additionally, fisherfolk are not assigned specific tasks and are required to do any job.

5. Conclusion

The researchers used several statistical methods to answer study questions and fulfill the paper's main purpose. According to data, the 327 fisherfolk in Jala-Jala, Rizal, are 51–55 years old and have 7–12 years of experience. The researchers found that fisherfolk's repetitive net pulling, fish scooping, and rope tugging pose ergonomic dangers. Rapid Entire Body Assessment Analysis classifies all three fishing activities as Action Level 4, indicating high danger. It shows that daily activity pain affects respondents' hips (34.56%), back (31.50%), and shoulders (15.60%). The

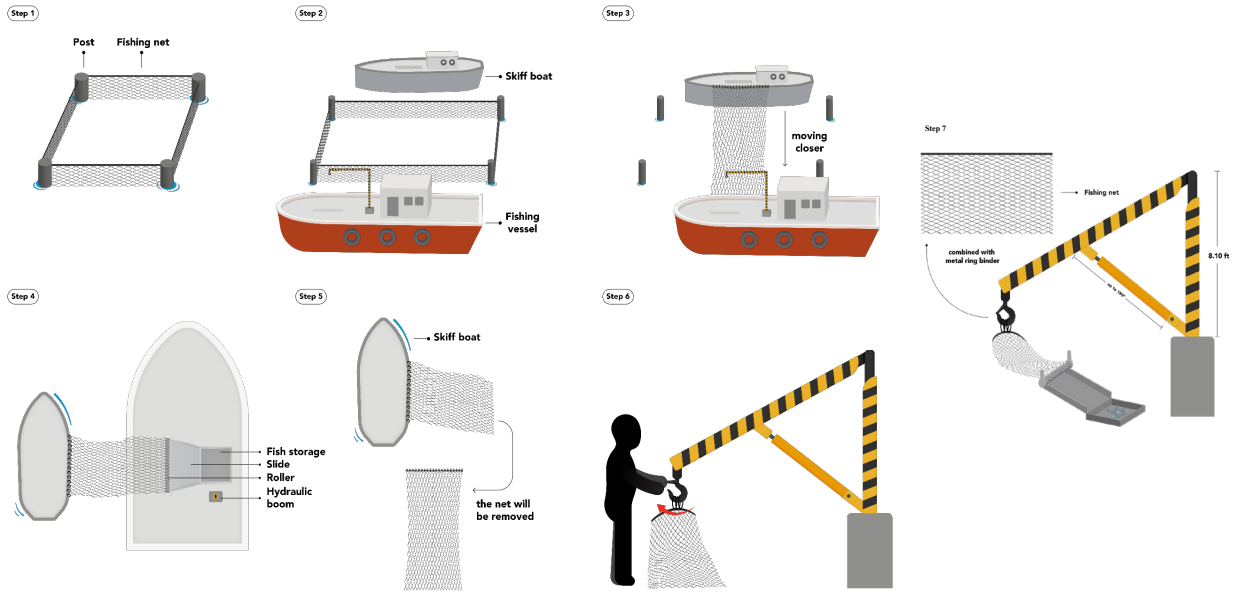
researchers also found that the environment affects fisherfolk's performance. The more hazardous conditions exist inside the boats of fisherfolk and fishing vessels, the more uncomfortable the working environment.

Several fisherfolk laborers are in varying temperatures, which makes them uncomfortable. Based on the data, there is a substantial association between the frequency of usage of personal protective equipment and the physical discomfort experienced by fisherfolk, indicating how safe it is for them to fish with or without PPE. Fishermen's workplace safety and health are also affected by the lack of material handling seminars. Due to these characteristics, the researchers were able to build ergonomic fishing equipment that reduced fisherfolk body discomfort and a working process architecture that improved their working circumstances in Jala-Jala, Rizal, which was the study's main goal.

6. Recommendation

From the present study, the researchers propose ergonomically designed fishing equipment and methods among fisherfolk in Jala-Jala Rizal to contribute to the reduction of musculoskeletal disorders (MSDs), to improve their work conditions, processes, and other risk factors experienced by these fishery workers. To go into more detail, the following ergonomically designed fishing equipment and methods are presented or proposed.

Figure 6.1 Simulation of the design equipment



As shown above, **Step 1** starts the fishing process. A square fish compartment has four posts on each side and a net to protect the development area of the fish. Fishermen in Jala-Jala, Rizal, refer to it as the fish pen.
Step 2 is the procedure where the fishing nets will detach from the posts and attach to the roller located in the fishing vessel on one side and the skiff boat on the other using ring binders to do so
Step 3 illustrates that once the net is attached to the skiff boat and fishing vessel it will move towards each other to create a smaller space in which the fish will be gathered so that the fishes are easier to catch.
Step 4 shows how the fishnet spins around the roller, compressing it. The fish could also slide into the storage as the roller spun. The fishnet will wrap precisely around the roller due to net barriers on both ends.
Step 5 depicts the next steps where the fishnet with a metal ring from the skiff boat will be removed or relocated by fisherfolk as part of the fishing process.
Step 6 illustrates the process where the fisherfolk transfers the fishnet that is attached to the skiff boat to the hydraulic boom's hook using the metal ring on the end of the fishnet. While the other end of the fishnet is tied to the roller.
Step 7 depicts what happens when the fishnet is attached to the hydraulic boom's hook. As the rollers continue to spin, the hydraulic boom lifts the net and delivers the fish to the slide faster. This new and improved design eliminates the scooping step, simplifying the process.
The researchers also advised the implementation and practicing of 5S among fisherfolk workplaces to perform their occupation efficiently, effectively, and safely. The table that follows illustrates the improvement in work processes and safety of fisherfolk using the 5S Lean Methodology.

Table 6.1 Recommendations with 5S

5s	Standards to be met/ Solutions
Sort	Fisherfolk in Jala-Jala, Rizal should properly organize and store nets, ropes, buckets, and anchors in designated areas to prevent accidents and damage. They should also wear personal protective equipment and organize tools and equipment to avoid unstable footing and improper posture. Barangay leaders of Jala-Jala, Rizal should hold regular meetings to remind fisherfolk of these safety measures.
Set in Order	All equipment should be placed in accordance with its level of utilization.
Shine	Fishery workers are required to regularly clean and sanitize their workspace and equipment, maintain their machinery, and keep their fishing vehicles and equipment neat and comfortable in order to prevent accidents and ensure long-term viability. To prevent slips on the large fishing vessel, fishery workers can use safety equipment such as rain boots and regularly wipe wet or slippery areas inside the boat. Weekly inspections of machinery and regular cleaning of equipment are also important for ensuring their safety.
Standardize	Standard operating procedures for arranging, handling, and cleaning all of the associated machines and equipment
Sustain	Provide workers (fisherfolk) with training, seminars, and evaluations to ensure continuous 5s and safe working conditions

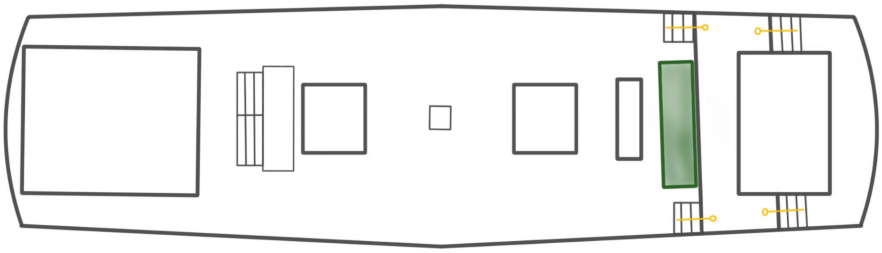


Figure 6.2 Fishing Vessel Floor Plan Layout

Recommendations for the Local Government Unit in the Agricultural Sector in Jala-Jala, Rizal

The local government in Jala-Jala, Rizal should provide fishing equipment, personal protective equipment, and medical assistance to fisherfolk to ensure their safety and well-being. They should also provide fish feed and nutrition to promote the production of additional fish species. The government should also study the impact of water hyacinth pollution on fisherfolk's working conditions and improve supervision in the fishing industry to ensure the value of their work and safety.

Recommendations for the Future Researchers

This publication or paper is meant to be used as a study on occupational safety and health and work-related musculoskeletal diseases in the context of fisherfolk in Jala-Jala, Rizal. The researchers suggest that similar studies should be conducted in other regions or nationwide. They also recommend upgrading fishing instruments and methods and researching material handling and fishing techniques to improve efficiency. Future researchers should use ergonomic or statistical technologies to accurately measure musculoskeletal issues and improve occupational safety and health.

References

Abd Rahman, N. I., Md Dawal, S. Z., Yusoff, N., & Mohd Kamil, N. S. , Anthropometric measurements among four Asian countries in designing sitting and standing workstations. *Sādhanā*, *43*(1),2018. https://doi.org/10.1007/s12046-017-0768-8

Borah, B., Ergonomic Hazards Associated with Freshwater Aquaculture and Possible Mitigation Measures. Advances in Ergonomics in Design, 348–358, 2018. https://doi.org/10.1007/978-3-319-94706-8_39

Campos, M., Basic occupational safety and health for small-scale fishing workers in rural communities in Latin America using a community-based approach, 2020. https://tinyurl.com/yc83dmk7

Daika, N., Correlation between Working Postures and The Complaints of Musculoskeletal Diseases of The Fishermen in Tanjung Village, Sumenep District. The Indonesian Journal of Occupational Safety and Health, 8(3), 258-264, 2019. https://www.e-journal.unair.ac.id/IJOSH/article/view/8699

Dogelio-Naga, M., et al., The development of an ergonomically designed automatic fishing net to reduce WMSDs risk among the small and medium scale fishermen. *KnE Social Sciences*, *3*(6), 911, 2018. https://doi.org/10.18502/kss.v3i6.2428

Doza, S., Bovbjerg, V. E., Vaughan, A., Nahorniak, J. S., Case, S., & Kincl, L. D., Health-Related Exposures and Conditions among US Fishermen. Journal of Agromedicine, 27(3), 284–291, 2021. Retrieved from: https://www.tandfonline.com/doi/full/10.1080/1059924X.2021.1944416

Fragoso, J., Borges, G., Carvalho, M., & Ramos, M., Musculoskeletal Disorders In Countryside Fishermen Of Amazonas-Brazil. Retrieved from, 2018: https://tinyurl.com/4fusamx3

Ishikawa, H., & Yagura, C., Investigation of Musculoskeletal Symptoms and Related Factors in Fishermen. Rigakuryoho Kagaku, 37(4), 405-411, 2022.https://tinyurl.com/42dk2e8v

Müller, J. dos, da Silva, E. M., & Franco Rego, R., Prevalence of musculoskeletal disorders and self-reported pain in artisanal fishermen from a traditional community in Todos-os-Santos Bay, Bahia, Brazil. International Journal of Environmental Research and Public Health, 19(2), 908, 2022. https://doi.org/10.3390/ijerph19020908. Retrieved from: https://tinyurl.com/2wp98hk4

Ngaruiya, F. W., Ogendi, G. M., & Mokua, M. A., Occupational Health Risks and Hazards Among the Fisherfolk in Kampi Samaki, Lake Baringo, Kenya. Environmental Health Insights, 2019. https://doi.org/10.1177/1178630219881463

Philippine Statistics Authority. (n.d.). Fishery Resources 3. https://psa.gov.ph/content/fishery-resources3

European Foundation for the Improvement of Living and Working Conditions. (2007). *Fourth European Working Conditions Survey*.

Remmen, L. N., Heiberg, R. F., Christiansen, D.H., Herttua, K., and Berg-Beckhoff, G. , Work-related musculoskeletal disorders among occupational fishermen: A systematic literature review. Occupational and Environmental Medicine, 78(7), 522–529, 2020. https://doi.org/10.1136/oemed-2020-106675. Retrived form: https://tinyurl.com/2h27djpd

Sandsund, M., Wiggen, Ø., Holmen, I. M., & Thorvaldsen, T., Work strain and thermophysiological responses in Norwegian fish farming - a field study. Industrial Health, 60(1), 79–85, 2022. https://doi.org/10.2486/indhealth.2020-0259

Thamrin, Y., Pasinringi, S., Darwis, A. M., & Putra, I. S., RelatCasesf body mass index and work posture to musculoskeletal disorders among fishermen. Gaceta Sanitaria, 35, S79-S82, 2021. https://tinyurl.com/5n866d6y

Biography

Christine Joy B. Gallardo is a 4th-year student from Technological Institute of the Philippines - Manila, taking up a Bachelor of Science in Industrial Engineering, Certified Lean Six Sigma Yellow Belt practitioner. Former Public Relations Officer of the Department Student Council of Industrial Engineering 2021-2022. Member of Junior Philippine Institute of Industrial Engineers and Auditor 2022-2023. Member of TIP-Inhinyera 2022-2023.

Zina Marie G. Oliveros is in her 4th -year at the Technological Institute of the Philippines-Manila, taking up a Bachelor of Science in Industrial Engineering, Certified Lean Six Sigma Yellow Belt practitioner. Former Public Relations Officer (P.R.O.) of the Junior Philippine Institute of Industrial Engineering 2020-2021 and former Vice-President of the Department Student Council of Industrial Engineering 2021-2022. She is a member of the Junior Philippine Institute of Industrial Engineering and a member of TIP-Inhinyera 2022-2023.

Vazh Chloey V. Ople is a 4th-year student from Technological Institute of the Philippines - Manila, taking up a Bachelor of Science in Industrial Engineering, Certified Lean Six Sigma Yellow Belt practitioner. Member of Junior Philippine Institute of Industrial Engineers 2022-2023.

Etthandan Zeus C. Protacio is a 4th-year student from Technological Institute of the Philippines - Manila, taking up a Bachelor of Science in Industrial Engineering, Certified Lean Six Sigma Yellow Belt practitioner. Former Auditor of the Department Student Council of Industrial Engineering 2020-2021. Member of Junior Philippine Institute of Industrial Engineers 2022-2023.

Kenneth Dane S. Sibulan is a 4th-year student from Technological Institute of the Philippines - Manila, taking up a Bachelor of Science in Industrial Engineering, Certified Lean Six Sigma Yellow Belt practitioner. Former Treasurer of the Department Student Council of Industrial Engineering 2020-2021. Member of Junior Philippine Institute of Industrial Engineers 2022-2023.

Janina Elyse A. Reyes is an Associate Professor at the T.I.P. Industrial Engineering Department. She graduated from the University of the Philippines Diliman where she earned her bachelor's degree in Industrial Engineering and Operations Research. She then studied at Mapua University for her Master's Degree in Engineering Management.